Redes Complexas: teoria e algoritmos

DCC/UFMG - Graduação - 1º Semestre de 2010

PROGRAMA

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1) Descrição:

Este curso tem como objetivo estudar e entender como ocorre a interconexão entre ambientes sociais, tecnológicos e naturais e como o estudo das redes complexas leva à compreensão dessas conexões. Tópics incluem: como opiniões circulam nas redes, como movimentos politicos se espalham na Web, fragilidade e robustez das redes. Para isso o curso apresenta a teoria das redes complexas, e algoritmos relacionados a aplicações em ciência da computação, como Web, recuperação de informação, redes de sensores, etc. A teoria de redes complexas se aplica a outras áreas também, como redes sociais, economia, biologia e física. O curso focaliza a análise estática das estruturas de topologia das redes complexas e aspectos de evolução dinâmica (ex.: temporal). Os alunos deverão fazer um projeto envolvendo redes complexas, aplicando a teoria e desenvolvendo algoritmos em diferentes contextos. Os tópicos específicos estão descritos detalhadamente no item 4.

2) Pre-Requisitos

Os requsistos são conhecimentos básicos de probabilidades (ex.: variáveis aleatórias, expectância, probabilidade condiconal), mas que serão revisados quando aparecerem. Entretanto um dos objetivos do curso é construir modelos das redes e os alunos deverão se familiarizar com o tratamento matemáticos das redes.

3) Livro Texto:

***Networks, Crowds, and Markets: Reasoning About a Highly Connected World,* David Easley and Jon Kleinberg**

http://www.cs.cornell.edu/home/kleinber/networks-book/

Capítulos usados e que obrigatoriamente DEVEM ser estudados:

- Redes complexas e Grafos: 1, 2, 3, 4, 5
- Redes de Informação e Web: 13, 14 e 15
- Dinâmica das redes: 16, 17 e 18
- Modelos Estruturais: 19, 20, 21

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4) Tópicos e organização do curso

- 1. Overview
  - 1.1 Aspects of Networks
  - 1.2 Central Themes and Topics

- 2. Graphs
  - 2.1 Basic Definitions
  - 2.2 Paths and Connectivity
  - 2.3 Distance and Breadth-First Search
  - 2.4 Network Datasets: An Overview
- 3. Strong and Weak Ties
  - 3.1 Triadic Closure
  - 3.2 The Strength of Weak Ties
  - 3.3 Tie Strength and Network Structure in Large-Scale Data
  - 3.4 Tie Strength, Social Media, and Passive Engagement
  - 3.5 Closure, Structural Holes, and Social Capital
  - 3.6 Advanced Material: Betweenness Measures and Graph Partitioning
- 4. Networks in Their Surrounding Contexts
  - 4.1 Homophily
  - 4.2 Mechanisms Underlying Homophily: Selection and Social Influence
  - 4.3 Affiliation
  - 4.4 Tracking Link Formation in On-Line Data
  - 4.5 A Spatial Model of Segregation
- 5. Positive and Negative Relationships
  - 5.1 Structural Balance
  - 5.2 Balanced Networks and the Cartwright-Harary Theorem
  - 5.3 Applications of Structural Balance
  - 5.4 A Weaker Form of Structural Balance
  - 5.5 Advanced Material: Generalizing the Definition of Structural Balance

- 13. The Structure of the Web
  - 13.1 The World Wide Web
  - 13.2 Information Networks, Hypertext, and Associative Memory
  - 13.3 The Web as a Directed Graph
  - 13.4 The Bow-Tie Structure of the Web
  - 13.5 The Emergence of Web 2.0

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  - 18.1 Popularity as a Network Phenomenon
  - 18.2 Power Laws
  - 18.3 Rich-Get-Richer Models
  - 18.4 The Unpredictability of Rich-Get-Richer Effects
  - 18.5 The Long Tail
  - 18.6 The Effect of Search Tools and Recommendation Systems
  - 18.7 Advanced Material: Analysis of Rich-Get-Richer Processes

- 19. Cascading Behavior in Networks
  - 19.1 Diffusion in Networks
  - 19.2 Modeling Diffusion through a Network
  - 19.3 Cascades and Clusters
  - 19.4 Diffusion, Thresholds, and the Role of Weak Ties
  - 19.5 Extensions of the Basic Cascade Model
  - 19.6 Knowledge, Thresholds, and Collective Action
  - 19.7 Advanced Material: The Cascade Capacity
- 20. The Small-World Phenomenon
  - 20.1 Six Degrees of Separation
  - 20.2 Structure and Randomness
  - 20.3 Decentralized Search
  - 20.4 Empirical Analysis and Generalized Models
  - 20.5 Core-Periphery Structures and Difficulties in Decentralized Search
  - 20.6 Advanced Material: Analysis of Decentralized Search
- 21. Epidemics
  - 21.1 Diseases and the Networks that Transmit Them
  - 21.2 Branching Processes
  - 21.3 The SIR Epidemic Model
  - 21.4 The SIS Epidemic Model
  - 21.5 Synchronization
  - 21.6 Transient Contacts and the Dangers of Concurrency
  - 21.7 Genealogy, Genetic Inheritance, and Mitochondrial Eve
  - 21.8 Advanced Material: Analysis of Branching and Coalescent Processes

5) Bibliografia de Consulta: artigos

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6. Calendário de Aulas e Leituras de Capitulos (mandatório)

Março

Dia 2 - apresentação do curso – aula #1
Dia 4 – leitura do cap. [1] para discussão – aula #2
Dia 9 – leitura do cap. [2] – aula #3
Dia 11 – leitura do cap. [2] – aula #4
Dia 16 – leitura do cap. [3] – aula #5
Dia 18 – leitura do cap [3]– aula #6
Dia 23 – Nao haverá aula: leitura cap. [4]
Dia 23 – Não haverá aula: leitura cap [4]
Dia 30 – leitura cap [5] – aula #7

Abril

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Dia 01 – feriado
Dia 6 – leitura cap [13] – aula #8
Dia 8 – Prova #1
Dia 13 – leitura [13] – aula #9
Dia 15 – leitura cap. [14] – – aula #10
Dias 20 – leitura cap. [14] – aula #11
Dia 22 – recesso

Maio

Dia 4 – apresentação da proposta dos projetos –
Dia 6 – leitura cap [15] – aula #12
Dia 11 – leitura cap [15] aula #13
Dia 13 – leitura cap [16] aula #14
Dia 18 – leitura cap [16] aula #15
Dia 20 - reserva
Dia 25 - Prova #2
Dia 27 – leitura cap [17] aula #16

Junho

Dia 1 – leitura cap [17] aula #17
Dia 3 –feriado
Dia 8 – leitura cap [18] aula #18
Dia 10 - leitura cap [18] – aula #19
Dia 15 – leitura cap [19] aula #20
Dia 17 - leitura cap [19] aula #21
Dia 22 – leitura cap [20]
Dia 24 - leitura cap [20]
Dia 29 – leitura cap [21]

Julho

Dia 1 – leitura cap [21]
Dia 6 - Prova #3
Dia 8 - Reserva

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